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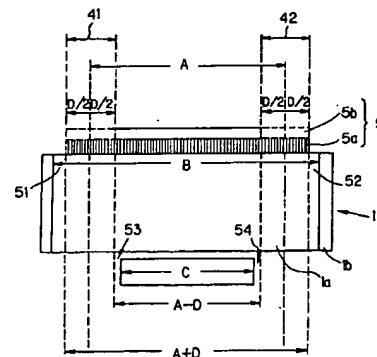
(54) An image forming apparatus.

(57) In an image forming apparatus, essential elements are provided so as to suffice either or both of the following relations:

$$\begin{aligned} C + D &< A < B - D \\ C &< E < A + D \end{aligned}$$

where A denotes a longitudinal dimension of the charging member; B denotes an effective longitudinal width of a photoconductive layer coated range on the charged member; C denotes a developing width in the longitudinal direction of a developing unit; D denotes a vibrating width of the charging member; and E denotes a longitudinal dimension of a cleaning member for the charged member.

Fig.10

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BACKGROUND OF THE INVENTION(1) Field of the Invention

5 The present invention relates to an image forming apparatus using electrophotographic process such as a photocopier, a printer and the like.

(2) Description of the Prior Art

10 In image forming apparatuses using so called electrophotographic process (Carlson process), corona charging devices that utilize the corona discharge phenomenon have been used as typical means for charging an electrophotographic photoconductor at a desired potential level. This method, however, requires a high voltage for causing discharge, which would give electric noises to various peripheral apparatuses. Alternatively, a large quantity of ozone gas that will be generated in discharging would give an unpleasant 15 feeling to people around the machine. To deal with these problems, as alternatives to corona discharging devices, a method has been proposed in which a photoconductor is charged by applying a voltage between the photoconductor and a conductive resin roller or conductive fibers. Nevertheless, this method suffers from another problem. That is, in a case of a conductive resin roller being used, if a micro-area of a photoreceptive layer of the photoconductor to be charged was peeled off and therefore part of a conductive 20 substrate such as aluminum, etc., is exposed, electric current from the roller would converge into the exposed portion, to thereby cause striped charging unevenness extending across the photoconductor in its axial direction. Meanwhile, brush type charging devices using conductive fibers can be roughly classified into two kinds, one of which has fibers planted on a belt-like strip and the other of which has fibers planted on a roller. Either of these could eliminate striped charging unevenness which would arise when the 25 aforementioned conductive resin roller was used.

Nevertheless, when the belt-like brush charging device is used with being fixed, another kind of image defect arises. Specifically, brushing stripes which run in the advancing direction of sheets arise on the image. This is because that each position across the longitudinal direction of the charged member or photoconductor always comes into contact with the same part of fibers on the charging brush. That is, if 30 some parts of fibers have less charging ability than other parts, the portion of the charged member contacting with the part of fibers having less charging ability will always be charged at a lower surface potential while the portion contacting with the part of fibers having higher charging ability will always be charged at a higher surface potential. This causes charging unevenness across the longitudinal direction of the charged member, thereby generating brushing stripes in the advancing direction of sheets. Further, 35 depending on the contacting strengths at contact points between the charging brush and the charged member, the degree of wear to the charging brush and the charged member will differ, that is, some parts will be worn out faster while other parts will not. As a result, charging failure would occur earlier at the portion having been worn out, to thereby shorten the lives of the brush and the charged member. To deal with this, it has been disclosed in Japanese Patent Publication Sho 63 No.43749 that the charging brush is 40 vibrated in the direction perpendicular to the moving direction of the charged member. Actual images created as the charging brush being vibrated were found out to be free from the brushing stripes running in the advancing direction of sheet which would appear when the brush was fixed. Further, it was confirmed that the lives of the charging member and the charged member were markedly lengthened.

Figs.1 and 2 are illustrative views showing configurations of prior art examples. In the figures, A, B, C 45 and D indicate:

- A: Length of a charging member;
- B: Effective width of a photoconductive layer applied on charged member;
- C: Developing width; and
- D: Vibrating width of the charging member.

50 Further, reference numeral 1 designates a photoconductor while numerals 1a and 1b denote a photoconductive layer coated range and a conductor substrate, respectively.

Initially, in the case shown in Fig.1, where A + D > B, when a charging member 5 is vibrated, the longitudinal extremes of the charging member 5 are made to interfere with the conductive substrate portion 1b on the charged member 1, giving rise to the following problems.

55 i) Current leak occurs at contacting portions 21 and 22 between the charging member 5 and the conductive substrate 1b, and in consequence, excessive current flows through the charged member 5, causing damage thereto.

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ii) In the case where capacity of the power source for the charging device is small or the charging device comes into contact with the conductive substrate 1b in a large area, very few of charges can be supplied to the photoconductive layer portion 1a or the non-conductive portion of the charged member 1, whereby the portions are isolatedly reduced in surface potential causing image defects.

5 The above problem can be solved when the contact width, i.e., A + D between the charging member and the charged member is set up to be shorter than the effective width B of the charged member. In other words, (the charging member length + the vibrating width) should be smaller than (the effective width of the photoconductive layer applied on charged member) or a relation "A + D < B" should hold.

10 Next, let us consider the case shown in Fig.2. When the charging member having a length of A with a vibrating width of D is brought into contact with the charged member to charge it, the width of the range within which the charging member is always in contact with the charged member is (A - D) and therefore only this region can be uniformly charged at a desired surface potential. If the length (A - D) is shorter than the effective developing width C, or C > A - D, the following problems occur.

15 i) Since edge regions 23 and 24 on the charged member 1 come in contact with the charging member 5 for a shorter time than the middle part and therefore the parts cannot be charged at as a high level as a surface potential desired, the overlapping areas 25 and 26 of these regions 23 and 24 with the developing width region C will be always toner-developed in the case where the reversal development as performed in laser printers is executed. This causes not only pollution of a transfer member used but also waste of toner. Further, the toner which could not be cleaned up and remains on the charged 20 member may adhere to the charging brush, whereby the charging brush might be deteriorated in its charging ability for prolonged use, resulting in occurrence of charging unevenness.

25 ii) Further, since development is always effected in the regions 25 and 26, toner particles, not having been collected efficiently for prolonged use, adhere to a conductive fabric cloth 5a, thereby causing charging unevenness and giving bad influences on resulting images. Further, the developer is consumed rapidly.

This problem can be solved by setting up the width (A - D) of the region which can always be charged at the desired level as to be greater than the developing width C. Therefore, a relation "A - D > C" should hold. It should be noted that this requirement can, of course, be applied to the normal development mode which is performed in photocopies and the like.

30 Japanese Patent Application Laid-open Hei 3 No.100673 discloses an idea which defines, in an image forming apparatus using a charging member with conductive fibers, dimensional relations as to its charging member width, developing width and charged member width.

Fig.3 shows an illustrative view schematically showing the principle of the idea. That is, this configuration aims at uniform charging of the entire surface of a photoconductive layer as well as extermination of smudge and failure of resulting images. To achieve these purposes, an insulating layer is provided on each 35 extreme of a conductive substrate 1b in order to prevent a charging member 5 from being short-circuited with a charged member 1 while specific limitations are imposed on effective widths of constituting parts. The technique shown in Fig.3, however, only specifies the length A of the charging member, the effective length B of the charged member and the developing width C so as to suffice a relation A > B > C. Still, this 40 technique can be applied only to configurations in which the charging member 5 is not vibrated. Accordingly, this technique is quite different from the art now being discussed in question in which the charging member 5 is vibrated, and naturally, the relation among the effective width A, B and C does not include the aforementioned vibrating width D. For this reason, the description of the technique of Fig.3 is mentioned only for reference and no further discussion on the technique of Fig.3 will be made.

45 Figs.4 and 5 are illustrative views showing other configurations of a prior art example. In the figures, A, B, C and D indicate:

- A: Length of a charging member;
- C: Developing width;
- D: Vibrating width of the charging member; and
- E: Length of a cleaning member.

50 Initially, in the case shown in Fig.4, where E < C, the following problem occurs.

i) There exist regions 27 and 28 in which it is impossible to collect developing particles, not having been transferred and therefore remaining on a charged member 1. This remaining toner adheres to a charging member 5. The thus adhered toner particles are further spread out to wider ranges by the vibrating charging member 5, polluting the image region. Moreover, the adherent particles fix to conductive fiber portions 5a of the charging member 5, thereby likely causing charging defects.

55 ii) With a charging member 5 made up of conductive fibers 5a being used, conductive fibers may come out from the charging member and the fallen fibers may adhere to the charged member 1 in the

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contacting width range between the charging member 5 and charged member 1. Particularly, existence of the fallen fibers adhered to places on the charged member near the image region, may have influence on image forming. Hence, removal of the fallen fibers is very important. Nevertheless, the aforementioned condition, i.e.,  $E < C$  is not enough for removing fibers fallen in regions 27 and 28.

5 In order to solve the problems above, it is necessary to make the width of the cleaning member wider than, at least, the effective developing width, that is, a relation " $E > C$ " must hold.

Next, let us consider the case shown in Fig.5, wherein a relation " $E > A + D$ " holds or in other words, a cleaning member is provided so as to reach regions 29 and 30 outside the contacting region ( $A + D$ ) between a charging member 5 and a charged member 1, where very few adherent substances such as 10 developer, fallen conductive fibers and the like exist on the charged member 1. In this case, the following problems occur.

i) In such regions 29 and 30 to which, in practice, only a few adherent substances adhere, frictional force generated between the cleaning member and the charged member 1 tends to become greater, therefore 15 a stronger load torque is required for driving the charged member 1. Further, when the cleaning member is of a blade-type, not only the blade may be bent backward but also this bent blade could cause damage to the charged member 1. Moreover, the cleaning structure becomes enlarged or bulky, disadvantageously raising its cost.

To solve the problem, it is necessary to set up the width  $E$  of the cleaning member smaller than the contacting width between the charging member 5 and the charged member 1. In one word, a relation " $E < A + D$ " must hold.

20 Japanese Patent Application Laid-open Sho 64 No.7070 discloses an idea which defines, in an image forming apparatus in which a charged member 1 is charged by bringing a charging member 5 into contact with the charged member 1, dimensional relations as to its charging member width, developing width and cleaning member width.

25 This technology originally assumes the use of an organic photo-conductor (OPC) as a charged member 1. Hence, the disclosure exemplified several experimental results for different kinds of OPCs. Fig.6 is an illustrative view schematically showing a typical configuration of the prior art technology. In this configuration, a relation is defined in which a width  $E$  should at least contain a region  $A_1$ , where  $A_1$  denotes the region across which a charging member 5 comes in contact with a charged member 1 while  $E$  denotes the 30 width of a cleaning member used. Here, the charging member 5 can be selected from those usually used such as of a roller type, a brush-type etc. Meanwhile, this disclosure refers to the reason why the above relation between the region  $A_1$  and the width  $E$  of the cleaning member should be defined, as follows. That is, if the adhered substances of extremely little quantity existing outside the contacting width between the charging member 5 and the charged member 1 are trapped in regions 31 and 32 between the charging 35 member 5 and the charged member 1, these particles trigger generation of pinholes especially when the charged member 1 is made up of those having a low surface hardness such as OPCs. Even if these pinholes exist in areas outside the image region, current leakage occurs when the charging member 5 comes in contact with the pinholes, thus causing adverse effect on resulting images.

The above-described effect is likely to happen or could occur mainly when the charging member 5 used is of a resin roller type or the like, but in the cases shown in Figs.1, 2, 4 and 5 in which the charging member 5 used is of a conductive fiber type, generation of pinholes hardly occurs due to adhered substances caught between the charging member 5 and charged member 1. Even the existence of pinholes 40 outside the image region will hardly cause any bad influence upon resulting images. Further, this disclosure does not have any reference to the configuration of the vibrating charging member 5. Meanwhile, although the aforementioned contacting region  $A_1$  between the charging member 5 and the charged member 1 is to correspond to  $A + D$ , or the charging member length  $A$  pulse the vibrating width  $D$  in the cases shown in Figs.1, 2, 4 and 5, it is impossible to discuss or treat the configuration shown Fig.6 equally with those cases 45 since no vibration of the charging member is effected in the configuration of Fig.6. Therefore, the description of the technique of Fig.6 is, again, to be considered as a reference and no further discussion will be made.

50 To sum up from the above discussion as to various prior art technologies, the following problems occur in the system in which the charging member 5 is brought into contact with the charged member 1 with the charging member 5 being vibrated.

First of all, as concerning the dimensional relation among the charging range width determined by the 55 width of the charging member 5 and its vibrating width, the width of the photoconductive layer coated range 1a on the charged member 1 and the developing width, the following problems occur.

1) In the case where the charging member 5 is in contact with the conductive portion 1b of the charged member 1, excessive current flows through the charging member 5, causing damage to the charging

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member 5. Alternatively, in the case where the capacity of a power supply for the charger is low or in the case where the charger is in contact with the conductive substrate 1b in a large area, electric charges are not sufficiently supplied to the photoconductive layer portion 1a, or the non-conductive portion of the charged member 1, whereby the portions are isolatedly reduced in surface potential causing image defects.

5        2) In the case where a region to be charged at a desired surface potential (length of the region corresponds to "the charging member length - the vibrating width") is shorter than the developing width, outer edge portions of the photoconductor corresponding to both extremes of the brush are not brought into contact with the brush for an enough long time, so that it is impossible to charge the portions at up to the desired level. Therefore, in the reversal developing process adopted as in laser printers etc., the outer edge portions with less surface potential levels always bear toner, causing smudge of the transfer member or waste of toner. Further, the toner which could not be cleaned up may adhere to the charging brush, whereby the charging brush might be deteriorated in its charging ability for prolonged use, bringing about unpreferable charging unevenness.

10      Next, as concerning the dimensional relation among the charging range width determined by the width of the charging member 5 and its vibrating width, the developing width and the length of the cleaning member, the following facts can be pointed out.

15      1) In order to collect the remaining developer on the charged member 1, it is necessary to make the cleaning member longer than the effective developing width. Further, in the case where the charging member 5 is made up of conductive fibers 5a, there is a fear that the conductive fibers 5a may fall out from the charging member 5. This is liable to occur within the contacting width range between the charging member 5 and the charged member 1. Particularly, the existence of the fallen fibers in locations near the image region might have influence on image forming, therefore, the removal of the fallen fibers is very important.

20      2) In contrast, if the cleaning member is too long, the frictional force between the cleaning member and the charged member 1 becomes greater in the regions to which, in practice, only a few amount of developer, fallen fibers and the like adhere, therefore, a stronger load torque is required for driving the charged member 1. Further, when the cleaning member is composed of a blade-type, not only the blade may be bent backward but also this bent blade could cause damage to the charged member 1.

25      30     Moreover, the enlarged or bulky cleaning structure unpreferably raises its cost.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to solve the above problems, and the gist of the invention resides in that an image forming apparatus comprises:

35      a charged member; and a charging member with conductive fibers, placed in contact with the charged member so as to share at least a contact surface or micro-space between the two members while being vibrated in directions perpendicular to a moving direction thereof wherein a voltage is applied between the charging member and the charged member so as to charge the charged member, and is constructed such

40      45     that essential elements are set up so as to suffice any one or both of the following relations (a) and (b):

(a)  $C + D < A < B - D$

(b)  $C < E < A + D$

45      where A denotes a longitudinal dimension of the charging member; B denotes an effective longitudinal width of a photoconductive layer coated range on the charged member; C denotes a developing width in the longitudinal direction of a developing unit; D denotes a vibrating width of the charging member; and E denotes a longitudinal dimension of a cleaning member for the charged member.

50      55     In the above configuration, it is effective that the charging member comprises a charging brush having conductive fibers affixed on a base thereof or a charging roller composed of a roller shaft with a conductive fiber cloth spirally swathed thereon.

By the above configuration, it becomes possible to provide an image forming apparatus which is able to use a practical developer with a charging member composed of conductive fibers and wherein the charging member can be prevented from being damaged so that good image printing can last for a prolonged period of time with reduced generation of ozone gas.

**EP 0 655 660 A2****BRIEF DESCRIPTION OF THE DRAWINGS**

Fig.1 is an illustrative view showing one configuration of one prior art example;  
 Fig.2 is an illustrative view showing one configuration of another prior art example;  
 5 Fig.3 is an illustrative view schematically showing a principle of one prior art system;  
 Fig.4 is an illustrative view showing another configuration of one prior art example;  
 Fig.5 is an illustrative view showing another configuration of another prior art example;  
 Fig.6 is an illustrative view schematically showing a configuration of another prior art system;  
 Fig.7 is a front view schematically illustrating an image forming apparatus as a target of the present  
 10 invention;  
 Fig.8 is a perspective view showing one example of a charging brush used in the present invention;  
 Fig.9 is a perspective view showing one example of a charging roller used in the present invention;  
 Fig.10 is an illustrative view showing a configuration of a first embodiment of the present invention;  
 Fig.11 is an illustrative view showing a configuration of a second embodiment of the present invention;  
 15 and  
 Fig.12 is an illustrative view showing a configuration of a third embodiment of the present invention.

**DESCRIPTION OF THE PREFERRED EMBODIMENTS**

20 The present invention will hereinafter be described in detail based on embodiments with reference to the accompanying drawings. It is to be understood that the present invention is not limited by the embodiments herein.

In the beginning, referring to Fig.7, one typical image forming apparatus as a target of the present invention will be explained. The description will be made on a case in which conductive fibers are planted 25 on a flat structure. A reference numeral 16 designates a controller which processes image-generating data transmitted from an unillustrated host computer. Subsequently, a signal that dictates start of image forming is sent to an engine controller 17. In response to the signal, a series of operations for image forming is executed in accordance with a predetermined sequence. Transfer sheets accommodated in a transfer sheet cassette 7 is successively drawn out one by one by a feed roller 8 and conveyed by conveyer rollers 9, 10 30 to a registration roller 11. A photoconductor 1 is rotated at a constant rate by an unillustrated rotating means. A charging brush 5 is pressed against the photoconductor 1 with a 1mm-biting margin. The charging brush 5 used here is composed as perspective shown in Fig.8 of a conductive base (made from aluminum, iron etc.) 5b and conductive fibers or conductive fiber cloth 5a affixed on the conductive base 5b. Here, the conductive fiber cloth 5a is formed with fibers or fiber aggregation made of, for example, 35 rayon with an adjusted amount of carbon dispersed therein so as to obtain a desired resistance. Conductive fibers of 4mm long were used for the charging brush of this embodiment. The charging brush can be vibrated by an unillustrated vibrating means in directions perpendicular to a moving direction of the photoconductor. The vibrating means used in the image forming apparatus of this embodiment can be varied in vibrating frequency f from 0 to 10Hz and in vibrating width D from 0 to 15mm. The photoconductor 40 used is an organic photoconductor (OPC) as used to be in the prior art.

Fig.9 is a perspective view showing a charging roller 5c which is applicable as the charging member of the present invention. This charging roller 5c is constructed of a roller shaft 5d and a strip of conductive fiber cloth 5a spirally swathed on the roller shaft 5d.

Meanwhile, in a developing unit 2, in order to assure that a magnet roller 2d may provide toner having a 45 predetermined toner density, toner powder is supplied from a toner tank 2e through an agitating roller 2a within, as required, by a supplying roller 2b to developer hopper 2f, and the thus supplied toner powder is agitated by a mixer roller 2c. During the agitation, the toner is electrified to bear charges of the same polarity with that of the voltage to be charged onto the photoconductor. In this state, when a voltage close to the surface potential of the photoconductor is applied to the magnet roller 2d, the toner powder adheres to 50 portion that an exposure writing head 6 has irradiated, and thus the latent image is developed. A registration roller 11 sends out a transfer sheet by measuring a timing so that the sheet may be positioned corresponding to an image on the photoconductor 1. The transfer sheet is nipped and conveyed between the photoconductor 1 and the transfer roller 3. During this, the transfer roller 3 is impressed by a voltage of an opposite polarity to that of the toner. Therefore, toner particles on the photoconductor 1 move onto the 55 transfer sheet. The transfer sheet having toner particles thereon is nipped and conveyed between a heat roller 12a with a heater 12c incorporated therein and a pressure roller 12b in a fixing unit 12. In this while, the toner particles are fused and fixed on the transfer sheet. Then, the transfer sheet is conveyed by a conveying roller 13 and a paper discharging roller 14 to a stack guide 15. Meanwhile, toner that has not

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transferred and remains on the photoconductor 1 is scraped from the photoconductor 1 by a cleaning member 4a of a cleaning unit 4. Thus scraped toner is sent by a toner conveying screw 4b to a used toner collecting container (not shown). Thus, a series of operations for image forming is complete. Here, in the present embodiment, three classes of blade-type cleaning members, i.e., 210mm, 230mm and 240mm in length were used. With the thus constructed image forming apparatus, the effect of the present invention was confirmed.

**Embodiment I:**

At the outset, description will be made on size of each element, that i.e., the charging member length A, the effective width B of the photoconductive layer coated range on the charged member, the developing width C and the vibrating width D of the charging member. Specifically, with 240mm of the effective width B of the photoconductive layer coated range and 217mm of the developing width C, the charging member length A and vibrating width D were set up as follows:

- 1) A : 235mm, D : 8mm  
(in the case of B < A + D, refer to Fig.1),
- 2) A : 225mm, D : 12mm  
(in the case of C > A - D, refer to Fig.2),
- 3) A : 230mm, D : 8mm

(in the case of C + D < A < B - D, refer to Fig.10).

In these conditions, actual operation of the apparatus was carried out and the following evaluation was obtained.

**In the case of condition 1):**

It was found that the charging brush, as vibrating, came into contact with the conductive substrate portion of the photoconductor, whereby current leak was caused in the regions 21 and 22 and consequently excessive current flowed. Further, damage to the charging brush, or burnt traces caused by the current were observed in both longitudinal extremes of the charging brush. In general, in the case of the brush-type charger, pinhole-wise contact of the charger with the conductive substrate portion does not cause such reduction of the surface potential in the image region as to influence the image quality. However, in this condition, periodical, laterally striped lines were observed on the image at places corresponding to the frequency of vibration of the brush. This is because, when the charging brush is oscillated to the utmost ends, the extremes of the brush, by 3mm long, are forced to come in contact with the conductive portion and consequently, sufficient charges cannot be supplied to the image region.

**In the case of condition 2):**

In the initial stage of the use, no defect was observed on the resultant images. However, a great deal of developer was observed to be adhered to parts on the transfer member corresponding to the outside of the image region or corresponding to regions 23 and 24 having a lower surface potential than a desired level. The thus adhered toner, if being left on the transfer member as it is, might smudge the backside of sheets with images when a contacting type transfer member is used. Alternatively, abnormal discharge might occur when a transfer member such as of a corona-discharge type is used. Anyway, if such toner exists, unpreferable effects occur. Further, it was observed that development was always effected in regions 25 and 26 so that developer particles, not having been well collected, adhered to the brush in prolonged use, thereby causing charging unevenness and giving bad influences on the resulting images. It was also confirmed that the developer was consumed rapidly, resulting in expensiveness.

**In the case of condition 3):**

This setup condition represents a first embodiment of the present invention (Fig.10). In this condition, no adverse effects as stated in the cases 1) and 2) occurred and good image forming was achieved. Specifically, neither current leakage occurred in regions 51 and 52 nor did occur undesired development in regions 53 and 54.

**Embodiment II:**

Next, description will be made on size of the charging member length A, the cleaning member length E, the effective developing width C and the vibrating width D of the charging member. Specifically, with 230mm of the effective width A, 217mm of the developing width C and 8mm of the vibrating width D, the cleaning member length E was set up as follows:

- 1) E : 210mm (in the case of E < C, refer to Fig.4),
- 2) E : 240mm (in the case of E > A + D, refer to Fig.5),

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3) E : 230mm

(in the case of C < E < A + D, refer to Fig.11).

In these conditions, actual operation of the apparatus was carried out, and the following evaluation was obtained.

5 In the case of condition 1):

There existed regions 27 and 28, in which it was impossible to collect remaining developing particles, without having been transferred. It was observed that this remaining toner had adhered to the charging member. As the operation was kept on in the situation, the thus adhered toner particles were further spread out to wider ranges by the vibration of the charging member, starting to pollute the image region. Further, prolonged use of the apparatus caused the adhered developer particles to fix to the conductive fiber portions of the charging member. As a result, charging unevenness was brought about, which caused adverse effects on the image forming. To make matters worse, it was observed that conductive fibers which had fallen from the charging brush existed on the photoconductor outside the cleaning region. Moreover, the fallen fibers entangled with the charging brush was also observed. Particularly, when fallen fibers became entangled with the charging brush on the downstream side thereof, the fibers blocked the exposure light, thus giving bad effects on the image.

10 In the case of condition 2):

The cleaning member used in this embodiment was of a blade type. The cleaning member of this kind received large frictional force from the photoconductor in regions in which very few adhered substances existed on the photoconductor, therefore the blade was observed to bend backward and this bent blade caused in some cases damage to the charged member.

15 In the case of condition 3):

This setup condition represents a second embodiment of the present invention (Fig.11). In this condition, no adverse effects as stated in the cases 1) and 2) occurred and good image forming was achieved. Specifically, in this case, developer particles and fallen fibers were removed properly even in the regions 55 and 56.

**Embodiment III:**

30 Fig.12 shows a structural view showing a third embodiment of the present invention. Here, each size of elements was set up as follows:

Charging member length A	230mm
Effective width B of the photoconductive layer coated range in the longitudinal direction	240mm
Developing width C	217mm
Vibrating width D	8mm
Length E of cleaning member for the charged member	230mm

40 That is, the following relation holds:

$$C + D < A < B - D \text{ and } C < E < A + D.$$

Image output was performed by using the thus set up image forming apparatus. As a result, this set up condition was found to be able to prevent the charging member composed of conductive fibers from being damaged and make it possible to use a developer effectively. Further, good image printing could last for a long period of time to linger the life of the apparatus. Besides, generation of ozone gas diminished. Here, it stands to reason that, in this case, the effects by both the above-described embodiments shown in Figs.10 and 11 can be obtained.

45 Although the above description of the embodiments has been made on the cases where flat type brushes are used as the charging members, use can be made of a pad-like charging member having a curved portion or the aforementioned roller-shaped charging member as shown in Fig.9. On the other hand, in the embodiments described above, blade-type cleaning members were used, but any other cleaner such as of electrostatic or magnetic cleaning type etc. can be applied to the present invention.

50 It is to be understood that the invention is not limited to the specific embodiments described above in association with the drawings, and various changes and modifications may be made in the invention without departing from the spirit and scope thereof.

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According to the present invention, it becomes possible to provide an image forming apparatus which is able to use a developer effectively with a charging member composed of conductive fibers and wherein the charging member can be prevented from being damaged so that good image printing can last for a prolonged period of time with reduced generation of ozone gas.

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**Claims**

1. An image forming apparatus comprising:

a charged member; and

10 a charging member composed of conductive fibers and placed in contact with said charged member so as to share at least a contact surface or micro-space between said two members, said charging member being vibrated in directions perpendicular to a moving direction thereof wherein a voltage is applied between said charging member and said charged member so as to charge said charged member,

15 characterized in that essential elements are set up so as to suffice any one or both of the following relations (a) and (b):

(a)  $C + D < A < B - D$

20 (b)  $C < E < A + D$

where A denotes a longitudinal dimension of said charging member; B denotes an effective longitudinal width of a photoconductive layer coated range on said charged member; C denotes a developing width in the longitudinal direction of a developing unit; D denotes a vibrating width of said charging member; 25 and E denotes a longitudinal dimension of a cleaning member for said charged member.

2. An image forming apparatus according to Claim 1 wherein said charging member comprises a charging brush having conductive fibers affixed on a base thereof.

30 3. An image forming apparatus according to Claim 1 wherein said charging member comprises a charging roller composed of a roller shaft with a conductive fiber cloth spirally swathed thereon.

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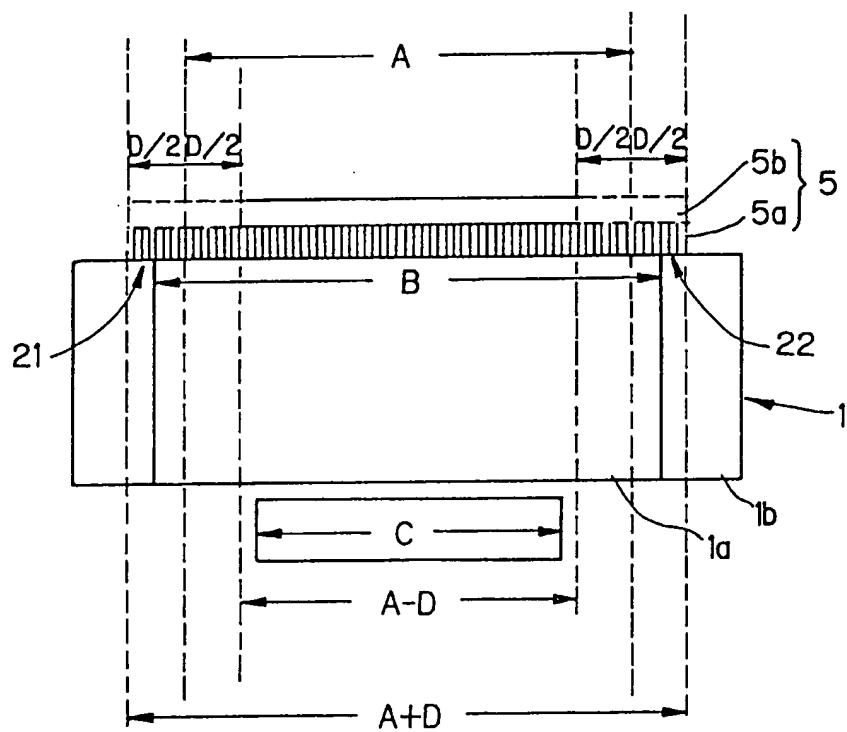
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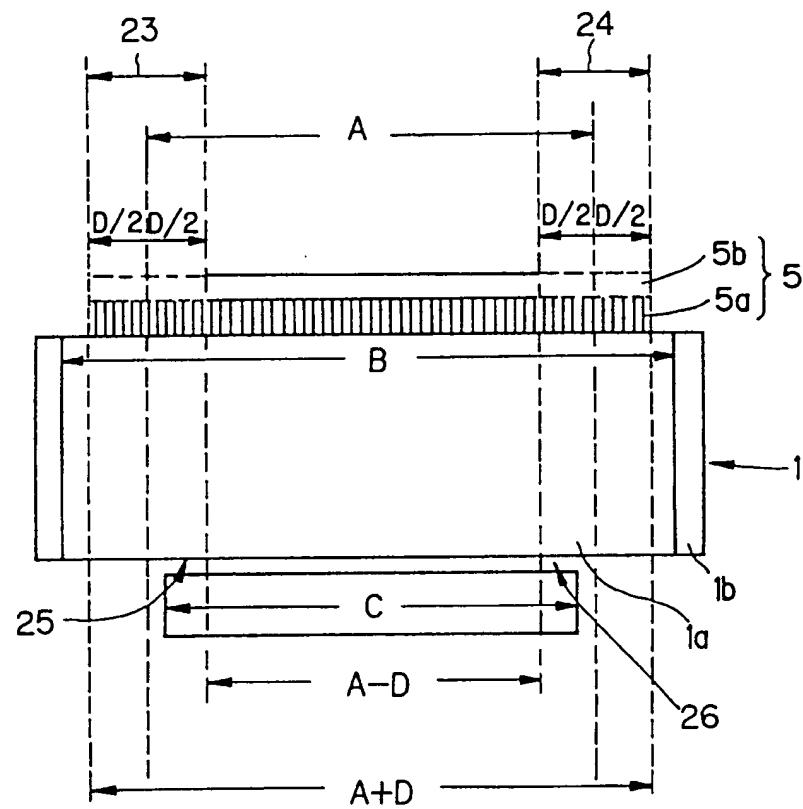
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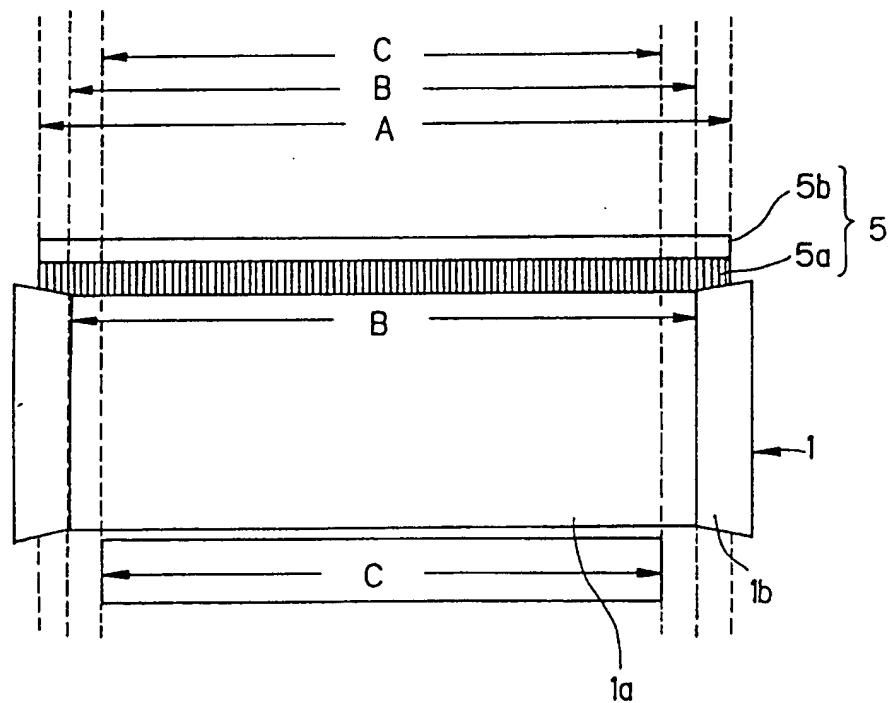
EP 0 655 660 A2

*Fig.1**PRIOR ART*

EP 0 655 660 A2

*Fig.2**PRIOR ART*

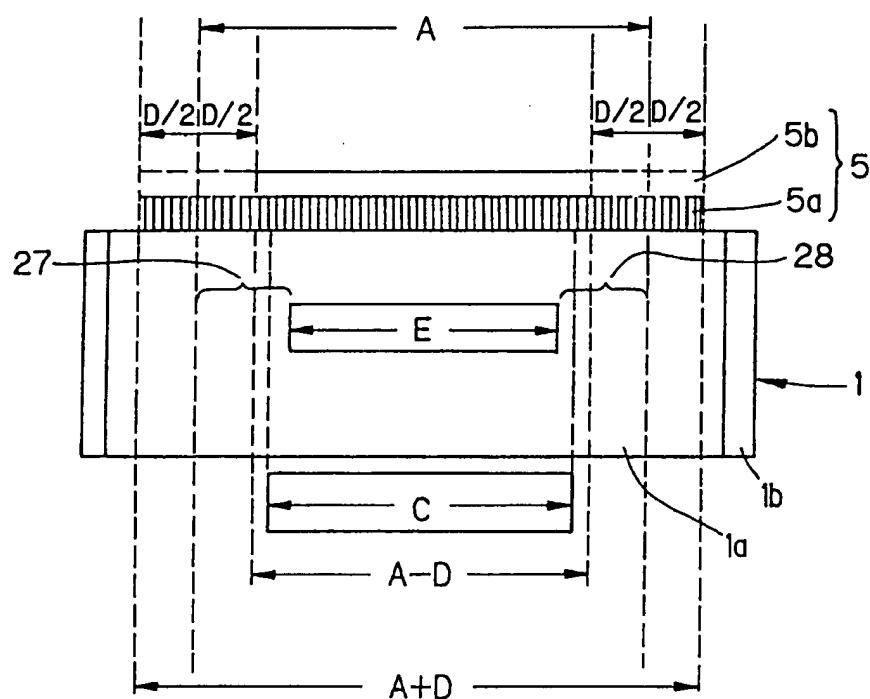
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*Fig.3**PRIOR ART*

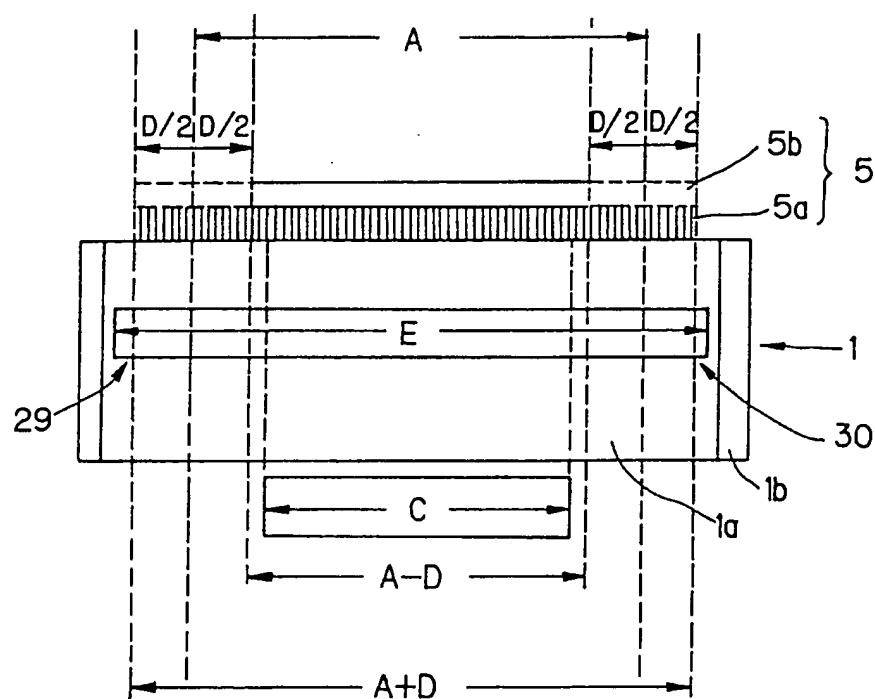
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Fig.4

## PRIOR ART

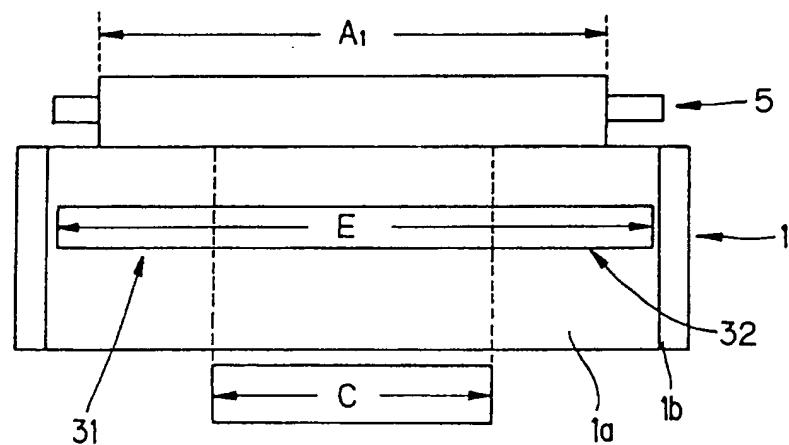


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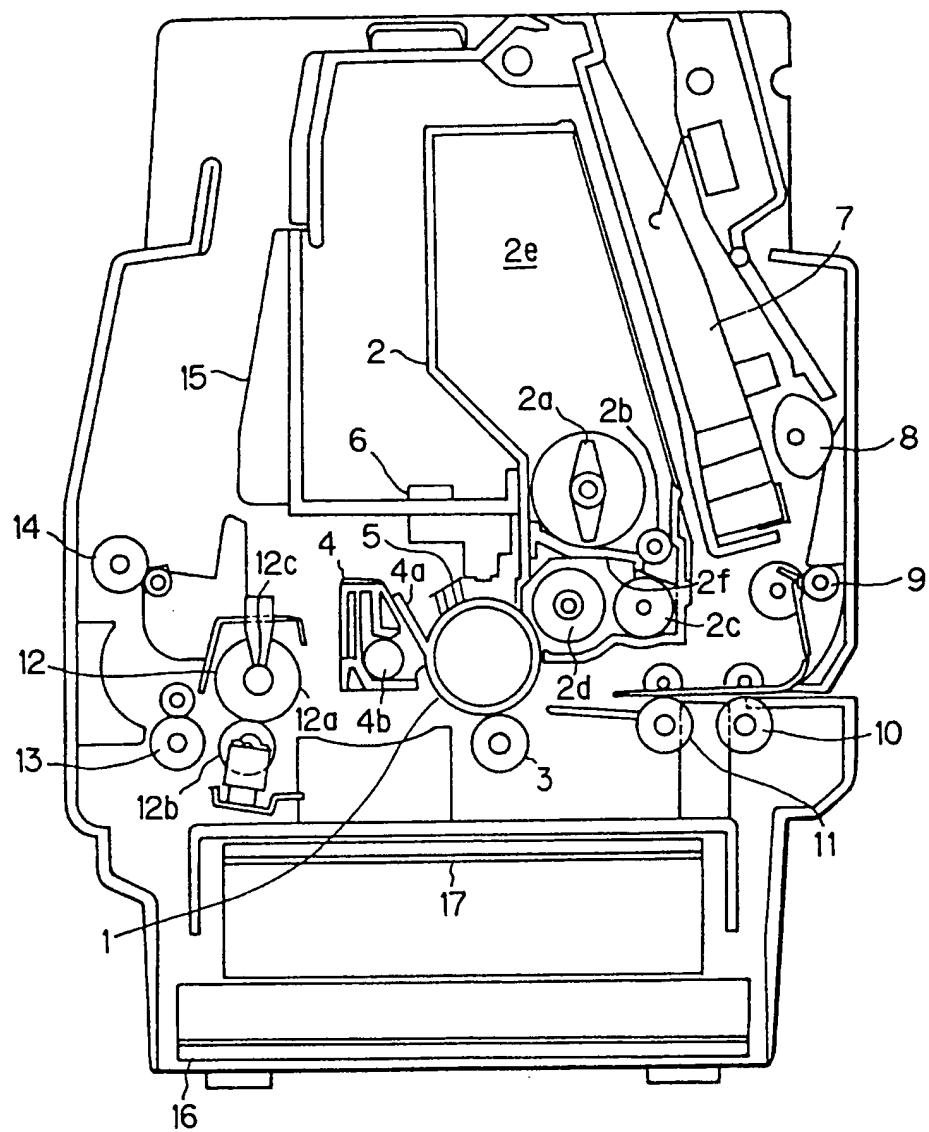
*Fig.5**PRIOR ART*

EP 0 655 660 A2

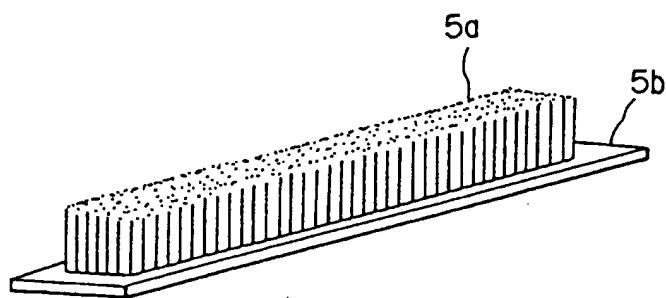
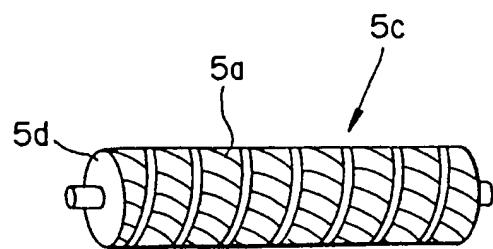
*Fig.6*  
*PRIOR ART*



EP 0 655 660 A2

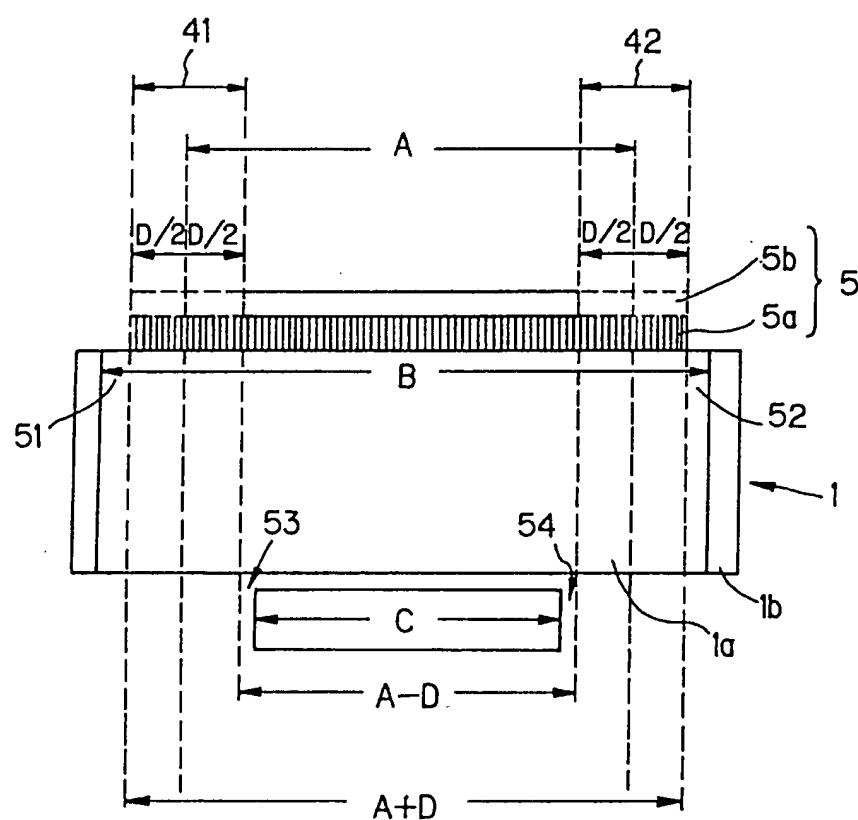
*Fig. 7*

EP 0 655 660 A2

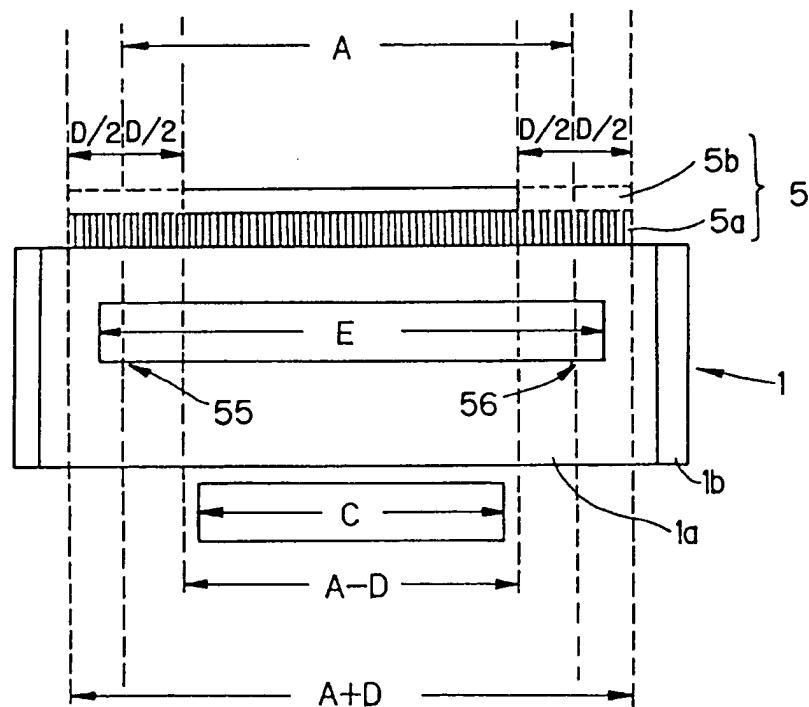
*Fig.8**Fig.9*

EP 0 655 660 A2

Fig.10



EP 0 655 660 A2

*Fig.11*

EP 0 655 660 A2

Fig.12

